REMARKS

Claims 1-5 are amended. New claims 14-26 are added. Claims 1-26 are currently pending in the application.

The amendments and new claims are supported by the application as filed and do not present new matter. See, e.g.:

p. 4, lines 9-10; p. 6, lines 23-25 (apparatus for growing bulk single crystal boules using a modified HVPE process);

p. 4, lines 19-20; p. 8, lines 29-33 (portion of the source tube extends outside of the reactor)

p. 7, lines 6-8 (reactor tube 103 has a cylindrical cross-section, other tube configurations can be used, such as a tube with a rectangular cross-section)

p. 7, lines 8-9 and p. 7, line 27 (source tube)

p. 7, lines 21-31; p. 11, lines 8-10 (location of sources controllably varied; control rod to alter position of boat and source; control rod is manually manipulated)

p. 7, line 25 (location of source can be controllably varied relative to the reactor tube)

p. 8, lines 4-11 (positioning of substrate)

p. 11, lines 15-19 (Al source is appropriately positioned within reactor to achieve desired temperature)

Fig. 1 (substrate in reactor tube and separate from extended gallium source)

Applicants have amended certain claims to further recite the structural limitations of the claim, in particular, that the position of the extended gallium source is controllable. Applicants respectfully submit that the claims recite structural limitations and are novel and non-obvious over the cited references. Reconsideration of the application, as amended, is respectfully requested.

I. Independent Claim 1 Is Patentable Over Yanashima In View of Miyazaki

Independent claim 1 is rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Patent No. 5,993,542 to Yanashima *et al.* ("Yanashima") in view of U.S. Patent No. 4,853,078 to Miyazaki ("Miyazaki").

Under 35 U.S.C. §103(a), to establish a *prima facie* case of obviousness of a claim, all the claim limitations must be taught or suggested by the prior art, and all words in a claim must be considered in judging the patentability of that claim against the prior art. MPEP §§2143; 2143.03; *In*

re Royka, 490 F.2d 981 (CCPA 1974). Moreover, there must be some suggestion or motivation to modify the reference, and a reasonable expectation of success. MPEP §§2143.01-2143.03; *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680 (Fed. Cir. 1990). Further, a proposed modification of prior art cannot render the prior art unsatisfactory for its intended purpose or change the principle of operation of the referenced. MPEP § 2145.

Applicants respectfully submit that Yanashima and Miyazaki cannot support the rejection of claim 1 under 35 U.S.C. §103(a).

A. Office Action Concessions Concerning Yanashima

Initially, the Applicants acknowledge that the Office action states that Yanashima fails to disclose or suggest "an extended gallium source within a multi-zone gallium source zone" as recited in claim 1. (Office Action, p. 2).

Applicants also acknowledge that the Office action states that Yanashima fails to disclose or suggest wherein "said multi-zone heater maintains a first portion of said extended gallium source at a first temperature greater than 450°C. while simultaneously maintaining a second portion of said extended gallium source at a second temperature in the range of 30°C. to 100°C., wherein upon reaction initiation said second portion comprises at least 50 percent of said extended gallium source" as recited in claim 1. (Office Action, p. 2-3).

B. Yanashima Does Not Disclose Or Suggest An Extended Gallium Source Being Controllably Positionable

In addition to these deficiencies, Yanashima fails to disclose or suggest "said extended gallium source being controllably positionable" as recited in claim 1. The subject application explains that the location of a source relative to a reactor tube can be controllably varied. Having an extended gallium source that can be controlled in this manner advantageously allows the multi-zone heater to maintain a different portions of the extended gallium source at different temperatures. (p. 7, lines 24-26).

Yanashima, on the other hand, explains that boats are set or fixed. Specifically, Yanashima states "the boat 132 is set" and that a boat is "set" or "put" on a partition plate. (Yanashima, col. 11,

line 37 ("set"); col. 11, line 40 ("put"); col. 11, line 43 ("set"). Thus, the source, which is not an extended gallium source as acknowledged in the Office action, also is not controllable and is not controlled so that the source can occupy different positions. Rather, Yanashima describes a source that is set or placed in a particular position and, therefore, is fixed or stationary.

C. Miyazaki Does Not Disclose Or Suggest An Extended Gallium Source

Applicants respectfully submit that Miyazaki, like Yanashima, also fails to disclose or suggest "an extended gallium source within a multi-zone gallium source zone." The subject application explains that an extended gallium source allows a portion of the source to be maintained at one temperature while another portion is maintained at another temperature. The amount of gallium undergoing a reaction is controllable and limited. (p. 4, lines 14-25).

The starting material that is described in Miyazaki is not a gallium source. (See, e.g., Miyazaki, col. 3, lines 1-17). Rather, Miyazaki explains "the starting material can be selected from a wide variety of combination of elements.... the elements selected ... can be combined..." (Miyazaki, col. 3, lines 1-4) (emphasis added). Accordingly, the starting material or melt is a combination of elements, not a gallium source, and not an extended gallium source.

D. Miyazaki Does Not Disclose Or Suggest An Extended Gallium Source Being Controllably Positionable

Further, Miyazaki does not disclose or suggest a reactor having a reactor tube, a substrate, a multi-zone heater, a growth zone, an extended gallium source, "said extended gallium source being controllably positionable..." as recited in claim 1. Rather, Miyazaki describes a tube 21 that is charged with a starting material and sealed. The sealed tube 21 is then heated so that the starting material melts to form a crystal. (Miyazaki, col. 5, lines 33-45; Fig. 1.) Thus, Miyazaki does not disclose or suggest an extended source being controllably positioned and does not disclose or suggest an extended gallium source being controllably positionable.

E. Miyazaki Does Not Disclose Or Suggest An Extended Gallium Source That Is Controllably Portioned To Provide Temperature And Portion Differentials

In addition, the cited reference does not disclose or suggest an extended gallium source that is "controllably positionable so that said multi-zone heater maintains a first portion of said extended gallium source at a first temperature greater than 450°C. while simultaneously maintaining a second portion of said extended gallium source at a second temperature in the range of 30°C. to 100°C., wherein upon reaction initiation said second portion comprises at least 50 percent of said extended gallium source" as recited in claim 1.

Rather, Miyazaki describes a reaction tube 2 having a starting material that is moved with respect to a furnace 8 so that the liquid-solid interface between the melt 9 in the boat 5 and a growing crystal 10 can be moved by changing the temperature. (Miyazaki, col. 5, lines 8-11). Miyazaki explains "the reaction tube 1 is moved slowly...so that the liquid-solid interface is also moved to grow a crystal 10." (Miyazaki, col. 4, line 67 - col. 5, line 1). Thus, it is clear from Miyazaki that the reactor tube is moved, not a gallium source. Further, as discussed above, Miyazaki does not disclose or suggest an extended gallium source and an extended gallium source that can be controllably positioned to achieve the recited temperature differentials and extended gallium source distributions.

F. Miyazaki Does Not Disclose Or Suggest An Extended Gallium Source Within A Multi-Zone Gallium Source Zone

Miyazaki also fails to disclose or suggest an extended gallium source at least partially in the reactor and "within a multi-zone gallium source zone." No such configuration is described in Miyazaki. Rather, the cited reference describes one growth zone in the reactor tube, which is defined between the melt and the crystal growth based on the temperature. (See, e.g., Miyazaki, Fig. 1 and line defining growth zone between melt 9 and crystal growth 10).

G. The Asserted Combination Is Deficient

In view of the above remarks, the asserted combination would not result in all of the elements and limitations of claim 2 assuming *arguendo* that the combination were made. Thus, the rejection under §103(a) cannot be maintained. MPEP § 2143.03.

H. The Required Suggestion Or Motivation To Combine The References Is Lacking

Initially, Yanashima does not suggest why an extended gallium source would be desirable. Further, the Office action has not set forth any basis concerning why a person of ordinary skill in the art would be motivated to modify Yanashima in this manner. Thus, the rejection under 35 U.S.C. §103(a) cannot stand

In addition, there is no suggestion or motivation to combine the references in view of substantially different systems and methods described in the cited references.

Yanashima is related to a method of fabricating a nitride III-V layer 2 on a substrate 1 using MOCVD. (Yanashima, col. 1, 30-31). Yanashima then explains that growth of a GaN layer 3 is progressed using a hydride VPE (HVPE) apparatus. (Yanashima, col. 5, lines 50-61; col. 6, lines 6-7; col. 7, lines 49-50). As is known in the art, Yanashima describes a method that involves flow of gases in the reactor and growth of semiconductor layers from a vapor phase.

Miyazaki, on the other hand, is directed to crystal growth "from the melt of a material composed of plural elements in a sealed reaction tube" using a three-temperature horizontal Bridgman system and method. (Miyazaki, col. 1, lines 44-45; col. 3, lines 50-51). Bridgman methods are well known methods that are used to grow crystals, as explained in Attachment 1, which is an article entitled "The Development of Crystal Growth Technology" and appears to have been published in 2003. Thus, this article is not prior art relative to the subject application but describes Bridgman methods for growing crystals.

The article states that Bridgman methods were known since 1923. (p. 6). Further, this article distinguishes Bridgman methods from other fabrication methods, including MOCVD and HVPE, which are known methods used for epitaxial growth. For example, the article states "Epitaxy has similarly separated from bulk crystal growth and has spit into ... 2. Epitaxy growth methods (VPE, MOCVD/MOVPE, MBE, ALE, LPE)." (P. 11). This article thus distinguishes Bridgman methods described in Miyazaki and methods, such as MOCVD and HVPE, which were traditionally used for epitaxial growth, and notes that the different technologies resulted in areas of specialization (p. 11).

Correspondingly, the system and method described by Miyazaki is not applicable and not related to MOCVD or HVPE. Thus, Miyazaki is not applicable to Yanashima. Further, the system and method described in Miyazaki do not involve flow of gases in a reactor (since the reactor is sealed), and is not related to growth of semiconductor layers from a vapor phase (since growth

occurs from the liquid phase or melt). Thus, Miyazaki describes a system in which growth occurs within a multi-component source, whereas MOCVD and HVPE involve a source that produces a gas or vapor, which is transported to a growth zone, and growth occurs in the growth zone from vapor.

Thus, there are fundamental and substantial differences between a liquid phase or melt based growth system, as described in Miyazaki, and a system and method involving vapor phase growth, as describe in Yanashima. Consequently, there would be no suggestion or motivation to make the asserted combination given the substantially different fabrication processes and systems that are described in Yanashima and Miyazaki. Moreover, Applicants submit that the combination of the cited references is impermissible hindsight. MPEP §2145. In view of the forgoing remarks, Applicants respectfully request that the rejection of independent 1 under 35 U.S.C. §103(a) be withdrawn.

II. Dependent Claims 2-5, 7, 8, 12 and 13 Are Patentable Over Yanashima In View of Miyazaki and Jacob

Dependent claims 2-5, 7, 8, 12 and 13 are rejected under 35 U.S.C. under 35 U.S.C. §103(a) as unpatentable over Yanashima in view of Miyazaki. These dependent claims incorporate all of the elements and limitations of independent claim 1 and add novel and non-obvious limitations thereto. Applicants respectfully submit that these dependent claims are also allowable in view of the amendments to claim 1 and the above remarks.

Applicants also identify further deficiencies in both Yanashima and Miyazaki. Thus, although the required suggestion nor motivation to combine the references is lacking, the asserted combination would still not result in all of the elements and limitations of claims 2-5, 7,8, 12 and 13, and the rejection cannot stand. MPEP § 2143.03.

Initially, Applicants respectfully submit that neither Yanashima nor Miyazaki discloses "said extended gallium source being controllably positioned so that upon reaction initiation said second portion comprises at least 90 percent of said extended gallium source" as recited in claim 2 and "said extended gallium source being controllably positioned so that said second temperature is in the range of 30°C. to 40°C" as recited in claim 3. The subject application explains that the reactor is configured and controlled in this manner so that a large quantity of the extended gallium source is maintained at a relatively low temperature which, in turn, results in limited reaction of the Ga source with a halide reactive gas. (P. 8, lines 22-29).

As acknowledged in the Office action, Yanashima does not disclose or suggest an extended gallium source as recited in claims 2 and 3. Further, neither reference discloses suggests an extended gallium source that is controllably positioned so that the reactor is configured in a manner such that upon reaction initiation said second portion comprises at least 90 percent of said extended gallium source" and "said second temperature is in the range of 30°C. to 40°C." Miyazaki does not disclose or suggest an extended gallium source, and is silent with regard to a reactor being configured and controlled to have the recited portions of gallium at the recited temperatures.

Applicants also respectfully submit that the cited references fail to disclose or suggest "said first aluminum source zone being controllably positioned so that said multi-zone heater maintains said first aluminum source within said first aluminum source zone at a third temperature greater than 700°C" as recited in claim 4 and "said first aluminum source zone being controllably positioned so that said multi-zone heater maintains said second aluminum source within said second aluminum source zone at a fourth temperature greater than 700°C." as recited in claim 5. No such structure and control of an aluminum source is described in the cited references.

III. Dependent Claim 6 Is Patentable Over Yanashima In View of Miyazaki and Jacob

Dependent claim 6 is rejected under 35 U.S.C. under 35 U.S.C. §103(a) as unpatentable over Yanashima in view Miyazaki and U.S. Patent No. 4,268,842 to Jacob ("Jacob"). Claim 6 incorporates the elements and limitations of independent claim 1 and adds novel and non-obvious limitations thereto.

The Office action relies on Jacob as disclosing a multi-zone heater. (Office action, p. 5). Jacob, however, does not cure the deficiencies of Yanashima and Miyazaki. Further, the required suggestion or motivation to combine Yanashima, Miyazaki and Jacob is lacking. As discussed above, Yanashima is related to a fabrication method using MOCVD and HVPE. (Yanashima, col. 1, lines 59-60). Jacob is also related to fabrication techniques that can be used for epitaxial growth. (Jacob, Abstract; col. 1, lines 9-17)). Miyazaki is not related to MOCVD or HVPE and instead, is directed to a process for growing a crystal using a Bridgman method. (Miyazaki, col. 4, lines 4-6).

In view of the forgoing remarks, Applicants respectfully request that the rejection of independent 1 under 35 U.S.C. §103(a) be withdrawn considering the deficiencies of the references and the different fabrication techniques and devices described in Yanashima, Jacob and Miyazaki.

IV. Dependent Claims 9-11 Are Patentable Over Yanashima In View of Miyazaki and Imaizumi

Dependent claims 9-11 are rejected under 35 U.S.C. §103(a) as unpatentable over Yanashima in view Miyazaki and U.S. Patent No. 5,266,127 to Imaizumi *et al.* ("Imaizumi"). These claims incorporate the elements and limitations of independent claim 1 and add novel and non-obvious limitations thereto.

The Office action relies on Imaizumi as disclosing a means for transferring a substrate (Office action, p. 6). Imaizumi, however, does not cure the deficiencies of Yanashima and Miyazaki. Further, the required suggestion or motivation to combine Yanashima, Miyazaki and Imaizumi is lacking. Yanashima is related to a method of fabrication involving MOCVD and HVPE. Imaizumi is also related to fabrication techniques capable of epitaxial growth. (Imaizumi, Title; Abstract). As discussed above, Miyazaki is not related to MOCVD or HVPE and instead, is directed to a process for growing a crystal using a Bridgman method. (Miyazaki, col. 4, lines 4-6).

In view of the forgoing remarks, Applicants respectfully request that the rejection of dependent claims 9-11 under 35 U.S.C. §103(a) be withdrawn considering the deficiencies of the references and different fabrication techniques and devices described in Yanashima, Jacob and Imaizumi.

V. New Claims 14-26 Are Patentable Over The Cited References

New dependent claims 14-26 incorporate all of the elements and limitations of independent claim 1 and add novel and non-obvious limitations thereto. Applicants respectfully submit that these claims are allowable based on the deficiencies described above and the lack of the required suggestion or motivation to make the asserted combinations. Applicants submit the following additional remarks to further demonstrate these claims are novel and non-obvious.

Claim 14 recites "the reactor ...being configured for use with a modified hydride vapor phase epitaxial (HVPE) process." (See, p. 4, lines 9-13). Miyazaki is clearly deficient with regard to claim 14, since the cited reference relates to a Bridgman method and does not disclose or suggest HVPE and a modified HVPE reactor and processes. Further, Miyazaki teaches away from claim 14 since Miyazaki explicitly states that it is directed to a growth from a melt or liquid phase within a sealed reaction tube. (Miyazaki, col. 2, lines 50-53). Further, Yanashima does not disclose or suggest a modified HVPE apparatus and process. Rather, Yanashima describes initially growing a GaN layer

2 on a substrate 1 using MOCVD, and then using conventional HVPE for subsequent growth of layer 3. (Yanashima, col. 5, line 31 - col. 6, line 7; Fig. 1B and 2).

Claim 15 recites the reactor including a "control rod, said control rod being manipulated to control the position of said extended gallium source." No such rod or manipulation of a rod to control the position of an extended gallium source is disclosed or suggested in Yanashima and Miyazaki.

Claim 16 recites "at least a portion of said extended gallium source being located outside of the reactor tube." Yanashima is deficient relative to claim 16 since Figures 2, 3, 5 and 7 of the cited reference all illustrate partition plates and boats being within the reactor tube. Miyazaki is also deficient relative to claim 16 since having a portion of the asserted "extended source" (which is not an extended gallium source) would necessarily involve substantial modifications to the structure and functionality of the reactor. See, Miyazaki e.g., col. 5, lines 33-45 (tube is sealed under vacuum with vapour pressure control material 26 and starting material).

Claim 17 recites "said extended gallium source being moveable between a first location and a second location." As acknowledged in the Office action, Yanashima fails to disclose or suggest an extended gallium source. Further, Yanashima fails to disclose or suggest an extended gallium source that source is not moveable since it is set on a partition plate.

Claim 18 recites "wherein the entire extended gallium source is within the reactor tube at both of the first and second locations." Yanashima is clearly deficient for the reasons set forth above.

Claim 19 recites "at least a portion of said extended gallium source is located outside of the reactor tube at least one of the first and second locations," and claim 20 recites "said extended gallium source being controlled so that the extended gallium source is moveable into and out of the reactor tube. Yanashima and Miyazaki are clearly deficient relative to claims 19 and 20 as discussed above.

Claim 21 recites "said extended gallium source comprising an extended gallium source tube." Applicants note that the Office action refers to an elongated source in Miyazaki. The cited sections of Miyazaki, however, describe a sealed reaction tube having a starting material, which is heated to form a crystal.

Applicants' claim 1, on the other hand, separately recites a reactor tube, a growth zone in the reactor tube and an extended gallium source, and claim 21 recites that the extended gallium source is an extended gallium source tube. Miyazaki, therefore, is clearly deficient with regard to claim 21.

Claim 22 recites "said extended gallium source being controllably moveable relative to the reactor tube." Yanashima is clearly deficient relative to claim 22, as set forth above. Further, Miyazaki is also clearly deficient relating to claim 22 since Miyazaki does not disclose or suggest an extended gallium source that is moveable relative to the tube. Rather, Miyazaki explains that the starting material is vacuum sealed inside the tube and melts, and that the reactor tube is moved to adjust temperature. (Miyazaki, col. 5, lines 33-38).

Claim 23 recites "said substrate being moveable independently of said extended gallium source." Miyazaki is clearly deficient relative to claim 23 since, assuming *arguendo* there is a substrate inside the reaction tube, the substrate moves with the starting material / melt, and therefore, does not move independently.

Claim 24 recites "said substrate being in the reactor tube and separate from said extended gallium source." Again, assuming *arguendo* that there is a substrate inside the reaction tube described by Miyazaki, the tube is sealed with the starting material / melt therein. Modifying Miyazaki so that the substrate is outside of or separated from the reactor tube would involve substantial modifications to the structure and functionality of the described reactor.

Claims 25 and 26 incorporate the elements and limitations of claim 1 and recite further temperature limitations that were previously recited in original claims 4 and 5.

VI. Conclusion

In view of the above amendments and remarks, Applicants respectfully request that application is in condition for allowance. If there are any remaining issues that can be resolved by telephone, Applicants invite the Examiner to contact the undersigned at the number indicated below.

Date: October 4, 2005

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